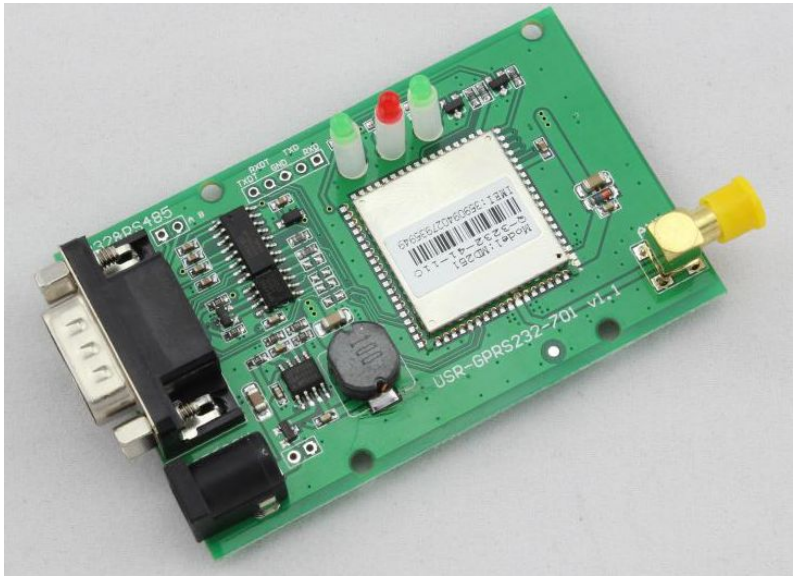
GPRS Data Transmit Unit

(USR-GPRS232-701)

File version: v1.6



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1. Product Description

1.1. Instruction

GPRS DTU (Data Transfer unit) is a wireless terminal equipment which can converter serial data to IP data or converter IP data to serial data, then transmit through wireless communication network. GPRS DTU is to use GPRS network to transmit data, it adopts industrial-grade embedded processor, embedded TCP/IP protocol stack. To provide users with virtual private networks, which is high speed, stable and reliable, data terminal online forever, and a variety of protocol conversion.

At present, this device have already been used widely in M2M industry, such as

- Electric power industry: 1. Electric remote meter reading 2. Substation monitor 3. Power line monitor 4. Switch monitoring system on distribution network column
- Water conservancy industry: 1. Water quality monitor 2. Reservoir gate remote control system solutions 3. Water conservancy GPRS scheduling system application solutions 4. Water pipe network monitoring system 5. Reservoir automatic monitoring system
- Oil industry: 1. Oil and gas well remote monitor 2. GPRS remote oil field automation monitoring system 3. Gas pipeline network monitoring system solutions
- Municipal industry: 1. Street lamp remote monitoring management 2. Pipe network remote monitor 3. City energy consumption monitor
- Environmental protection industry: 1. Pollution source monitor 2. Atmospheric environment monitor 3. Noise monitor 4. Dust monitor
- Agricultural applications: 1. Greenhouse remote monitor 2. Aquaculture farmers monitor 3. Water pump monitor and control
- Other industries: 1. Warehouse monitor management 2. Elevator remote monitor 3. Remote crane management system 4. Industrial energy consumption monitoring 5. Gas station GPRS data acquisition system 6. GPRS weather information collection system

1.2. Features

- Easy to use, only configurate few parameters
- Use MD251 industrial module
- Support TTL/RS232/RS485 interface, choose before purchase
- Using single module embedded protocol stack, no external CPU, higher stability
- Embedded TCP/IP protocol stack and GPRS technology
- Support remote parameters settings, can change IP, port, ect. by SMS

- Support GSM network, four frequency for global
- Support public and APN network access
- Can configure heartbeat pack data format, transmit interval, and keep connection with server. Can configure log pack data format and automatically establish network connection with server.
- Support data length control, can set the length of single sending package and data pack waiting time.
- Support ALWAYS ONLINE mode, and dropped reconnect.
- Completely transparent transmission, can take place of data transfer radio, no changes needed on your original system
- Use aluminum alloy case, shielding external disturbance effectively
- Matched sucker antenna, convenient for customers install and use inside the iron case
- Support four frequency, can be used all over the world

1.3. Parameters

- Working Voltage: 5-28v
- Working current: max 1200mA
- Working temperature: -20~75Celsius
- Storage temperature: -40~85Celsius
- Storage humidity: 5%~95%RH
- MAX transmit consumption: GSM900 class4(2W)
  DCS1800 class1(1W)
- Working Frequency: 850/900/1800/1900MHZ

2. Install

2.1. Packing list

◆ RS232 version:

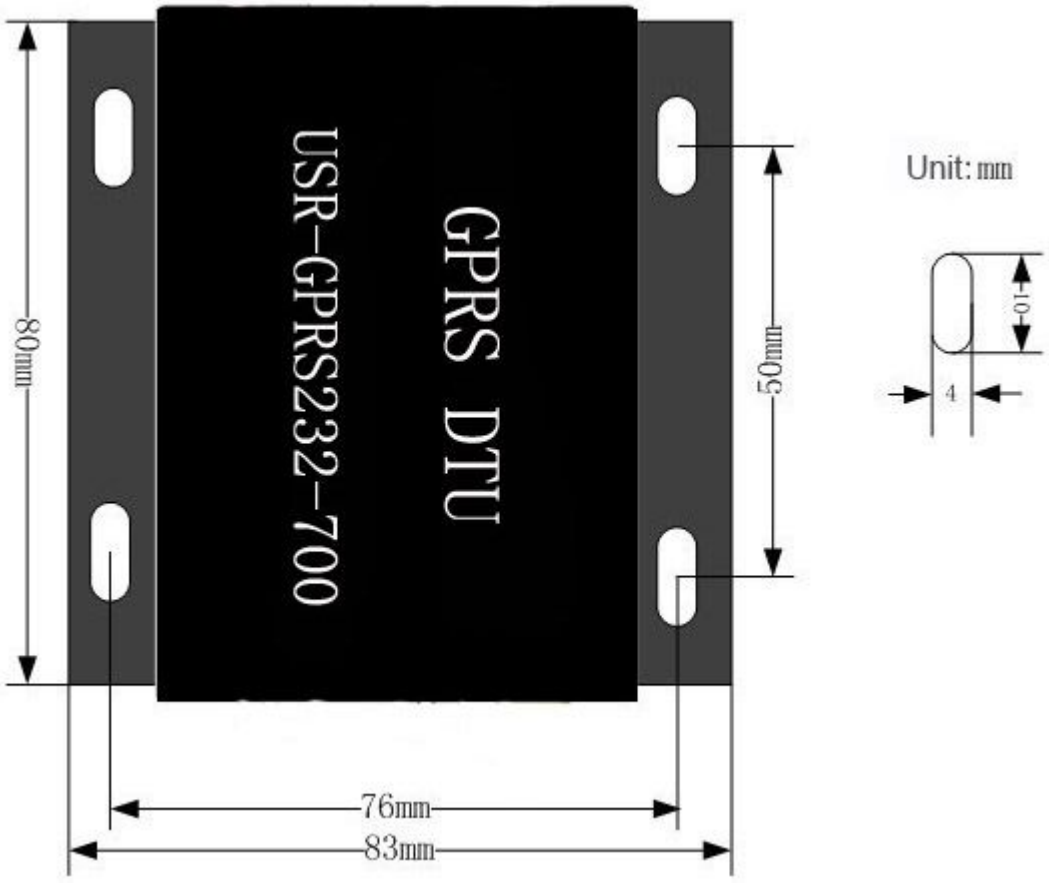
1. USR-GPRS232-701 with antenna * 1
2. Serial cable * 1
3. 12V1A power adapter * 1
4. User guide CD * 1

◆ RS485 version:

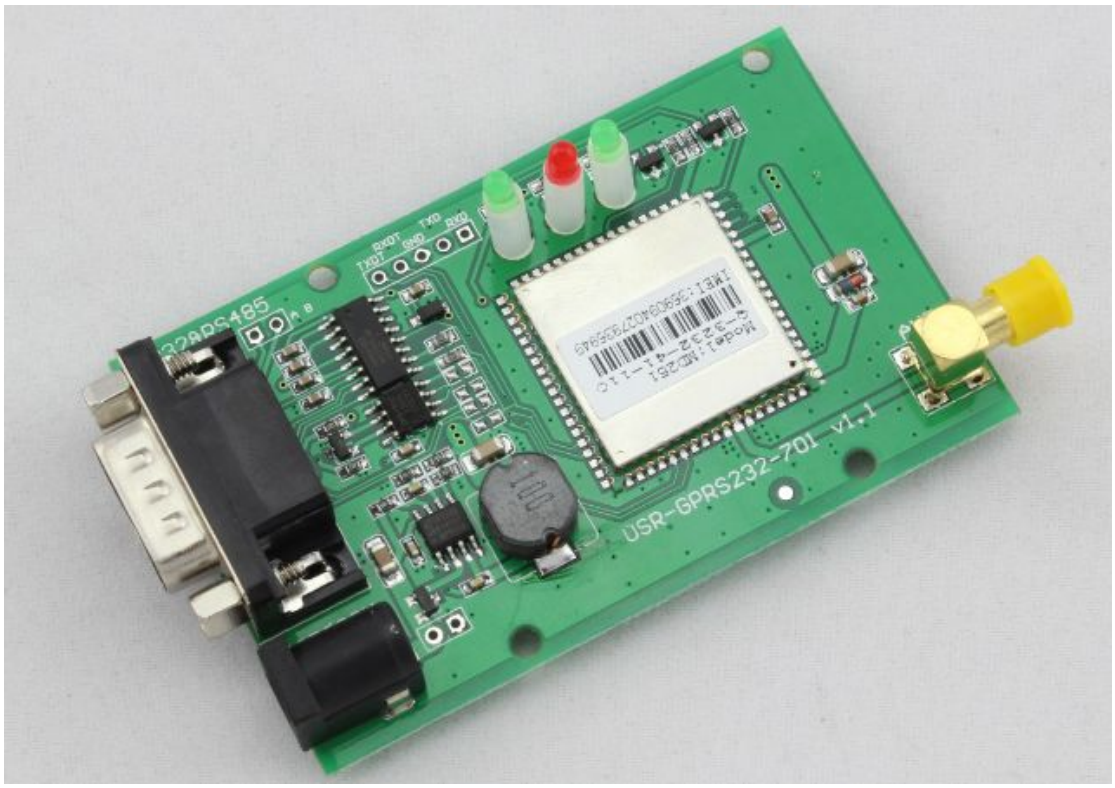
1. USR-GPRS232-701 with antenna* 1
2. 12V1A power adapter * 1
3. User guide CD * 1

2.2. Size and Diagram

DTU can be used independently, which packaged in metallic casing. It is easy to install by the fixed position of the hole on both side. Details as follows (unit: mm)



PCB size: 80 * 50mm



2.3. Antenna and SIM Card Installation

The antenna use SMA female base. Revolve the SMA male head to DTU antenna base, and ensure it is tightened, not to affect the signal quality.

When install or take out SIM card, firstly use a spike to insert the little yellow point on the right side of SIM base, then SIM cutting ferrule is open. SIM card should be put into cutting ferrule in first while installing, ensure metal face outside.

2.4. Power Supply

DTU is widely used in complex external environment. To adapt to its application and improve working stability of system, it use advanced power technologies, users can use our 5V 1A power adapter directly.

701 power supply ranges DC5~28V

2.5. Indicator Lamps

There are 3 indicators on DTU: “NET”, ”POW”, ”DATA”

index	name	description
1	PWR	On once power is on
2	NET	State Module function: Off Module is not running; 64ms On/800ms Off Module does not find the network; 64ms On/3000ms Off Module find the network; 64ms On/300ms Off GPRS communication;
3	DATA	When TCP link is established, it will on

2.6. Serial Port Instruction

2.6.1. RS232 Definition

RS232 port use 9 pin, female hole. Only three lines are defined, the rest is empty.

Diagram 2-2 RS232 interfaces

ID	Indicia	Function	Instruction
2	TXD	Device data transmit	RS232 level
3	RXD	Device data receive	RS232 level
5	GND	Ground	Communication common place

Diagram 2-3 RS232 Pin description

In order to debug easily, serial cable will be supplied for customer to connected with PC directly.

2.6.2. RS485 definition

Please inform us before order if you need RS485 version.

DB9 connector is the same as RS232 port on above photo. As to 6,9 pin of RS485, following function:

ID	Indicia	Function	Instruction
6	485-A	A pin of RS485	RS485 level
9	485-B	B pin of RS485	RS485 level

Diagram 2-4 RS485 pin description

As to RS485 equipment,we supply a DB9 pin connector and case for users make RS485 cables by themself.

2.6.3. TTL definition

Please inform us before order if you need TTL version.

DB9 connector is the same as RS232 port on above photo, use pin1, pin4 and pin9, following function:

ID	Indicia	Function	Instruction
1	RXD	Device data transmit	RS232 level
4	TXD	Device data receive	RS232 level
5	GND	Ground	Communication common place

Diagram 2-5 TTL pin description

3. Parameter Configuration

3.1. Hardware Connection

Configuration

Before configuration, you need to connect DTU with PC by serial cable and power on.

3.2. Parameter Configuration

- Software: Configuration by software in CD. Easy to configurate through PC .
- Command: Configuration by AT command. In this case, users just need serial communication program.
- Message: configuration by sending sms.

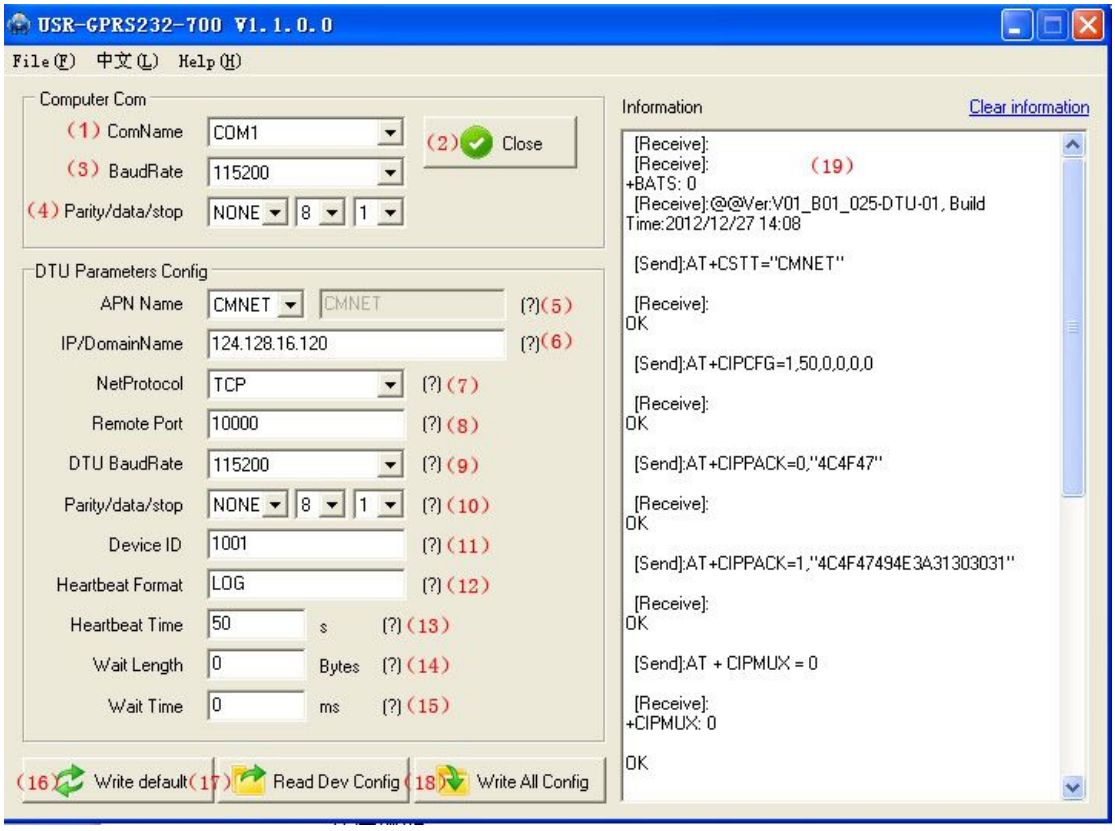
3.3. Software configuration

3.3.1. Software interface introduce

DTU access into AT command mode automatically after power on, within 2~40s, users can set parameters by serial port; If not, DTU will access to working mode, you need to set by sms after preparation of the GSM network.

Free setup software is supplied,

double-click to run, "USR-GPRS-DTU V1.0.exe", reference as below:



Software instruction:

1) Select PC serial port which connected with DTU

2) Serial port status: open closed
3) PC Baud rate(Default 115200 is okay. Will be modified according to (9))
4) PC Parity bit/data/stop bit(Default value.Will be modified according to (10))
5) Set DTU APN account
6) Set DTU destination IP or domain name
7) Set DTU network protocol
8) Set DTU destination port
9) Set DTU baud rate(Recommend default value 115200. If it is changed, the user also need to modify the above baud rate of PC.
10) Set DTU parity/data/stop bit(Recommend default value . If it is changed, the user also need to modify these above parameters of PC)
11) Set DTU ID
12) Set DTU heartbeat format
13) If specified need automatic reconnection when start the network link, then after the link is accidentally disconnected, waiting for <interval> seconds, will reestablish the server connection. This configuration effective for client only.

If specified need sending heartbeat packet when start the network link, in links space <interval> seconds, will automatically send heartbeat packet to server. This configuration effective for client only.

14) Device receive<waiting data size> bytes data, immediately sent to connected server.
15) When serial port receive less <wait for data size> bytes data, and the module waiting for <waiting data timeout> milliseconds later, still didn't receive serial data, then will start sending buffer data.
16) Restore default configuration
17) Read current configuration
18) Save current settings
19) Message area, show configuration information

3.3.2. Software operation

Configuration instruction

1. If you have already set up the IP and port number, after powering on, the power indicator light, the network indicator starts to flash quickly, when find network, the network indicator flashes once per second, then start mount GPRS network now. The network indicator flashes quickly, if you find the network in about 10-30s, then the network indicator flash quickly and the DATA indicator light and start flashing. It express that the device access to DTUGPRS transparent transmission mode.

2. 2s later after DTU powered on, you can make AT command configuration within 2~30 seconds

Operation:

Make sure serial cable connected with PC, software running and serial port opening. When DTU powered on again, it will show:

“+BATS: 0
@@Ver:V01_B01_025-DTU-01, Build Time:2012/12/27 14:08”

When it shows “device started, please finish read and configuration within 15 seconds”, then click "configure all parameters” (This operation should be finished before DTU mount GPRS, about 10-30 seconds. During this time, you can make the operation of reading, configuration; If overtime, you will need power on and operate again)

3.4. AT Command Configuration

Open serial testing software, and serial port corresponding with PC, power on again, the same steps as “3.3.2 software operation”. AT commands please refer to “6. AT commend instruction”

3.5. Message Configuration

In the case of GPRS network have been mounted by DTU, send short messages to configure, steps as follows:

1. Change IP

Message content
111888,setip:0,<ipaddr>
For example, IP is 182.32.116.166
So message content is 111888,setip:0,182.32.116.166
Return: SETIP OK

2. Change port

Message content:
111888,setport:0,<port>
For example, port is 7100
So message content is 111888,setport:0,710
Return: SETPORT OK

3. Inquiry DTU parameter

111888,status

4. Change Bund rate

111888,setbaud:115200

5. Restart DTU to work with new configuration

111888,reset
Return: RESET OK

When receive the correct return after sending messages, you need to send “command 5” (restart module to work with new configuration), then the device will work in your settings.

4. Public IP Instructions

DTU data can not be sent to device which has not been connected to internet or intranet. So public IP must be used in DTU application. Following is the description of public IP
Public IP is the address that the online PC obtained from Internet. PC with public IP and PC on Internet can access to each other.

NAT(Network Address Translator) realize intranet IP interconversion with public IP, transform mass intranet IP to one or less public IP addresses separately, to reduce the occupation of public IP address. The most typical application of NAT: In LAN, only need one computer connected to the Internet, you can use NAT to share Internet connection, made other computers in LAN can also surf the Internet. With NAT protocol, computers in LAN can get access to the computers on Internet, but computers on Internet cannot access to computers in LAN.

On windows operating system, the software of Internet connection sharing, sygate, winroute, unix/linux natd etc. all use NAT protocol to share Internet connection. The intranet internet access mode provided by ISP(Internet Service Provider) is based on NAT protocol.

The classification of public IP address

Class A: From 1.0.0.0 to 127.255.255.255, assigned to large network which has a large number of hosts but with fewer LANs.
Class B: From 128.0.0.0 to 191.255.255.255, generally used for international companies and government agencies

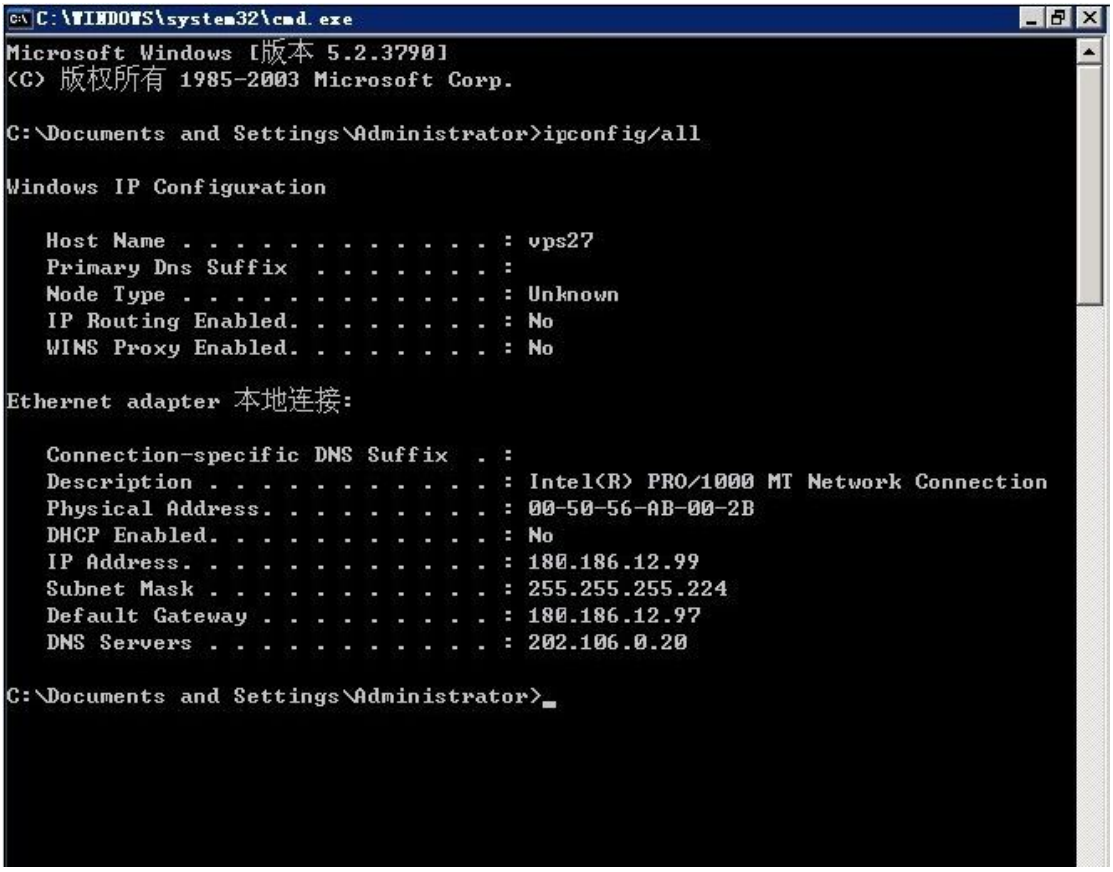
Class C: From 192.0.0.0 to 223.255.255.255, generally used for small companies, campus network and research institutions,etc

Class D: From 224.0.0.0 to 239.255.255.255, used for special purpose, also called “broadcast address”

Class E: From 240.0.0.0 to 255.255.255.255, Temporary retention

To judge if the computer has a public IP, you can operate like this to check:

Start- Run- input CMD- then Enter- input ”ipconfig/all”. As following picture: 180.186.12.99 is belong to Class B, it is an effective public IP address.


C:\WINDOWS\system32\cmd.exe
Microsoft Windows [版本 5.2.3790]
(C) 版权所有 1985-2003 Microsoft Corp.
C:\Documents and Settings\Administrator>ipconfig/all
Windows IP Configuration
Host Name . . . . . : vps27
Primary Dns Suffix . . . . . :
Node Type . . . . . : Unknown
IP Routing Enabled. . . . . : No
WINS Proxy Enabled. . . . . : No
Ethernet adapter 本地连接:
Connection-specific DNS Suffix . :
Description . . . . . : Intel(R) PRO/1000 MT Network Connection
Physical Address. . . . . : 00-50-56-AB-00-2B
DHCP Enabled. . . . . : No
IP Address. . . . . : 180.186.12.99
Subnet Mask . . . . . : 255.255.255.224
Default Gateway . . . . . : 180.186.12.97
DNS Servers . . . . . : 202.106.0.20
C:\Documents and Settings\Administrator>

Generally, we can distinguish whether the IP is public IP through following method:

- Usually, the machine that Telecom and Netcom through adsl dial-up obtain IP address, it should be public IP; Railtom broadband has NAT address translation, not public IP.
- Cable modems for dial-up Internet IP address, also public IP.
- GPRS wireless card (for laptop wireless Internet), the IP is Mobile GPRS internal IP, but because for GPRS DTU, they are from the same network, so they can also be used for connectivity.
- If users access to Internet through a router, and the router address is not the public IP through NAT translation, then we can adopt router port mapping, so the data can be forwarded through a router to your computer (Specific application diagram reference to chapter 5.2)
- If the machines IP is dynamic public IP, means the Internet IP is not fixed, it requires a

dynamic DNS software installed on the PC. DTU support DNS, so as long as users' applying domain name remains the same, DTU can also connect with them. There are many free DNS and domain name of the companies now, such as PeanutHull and Secco communication software.

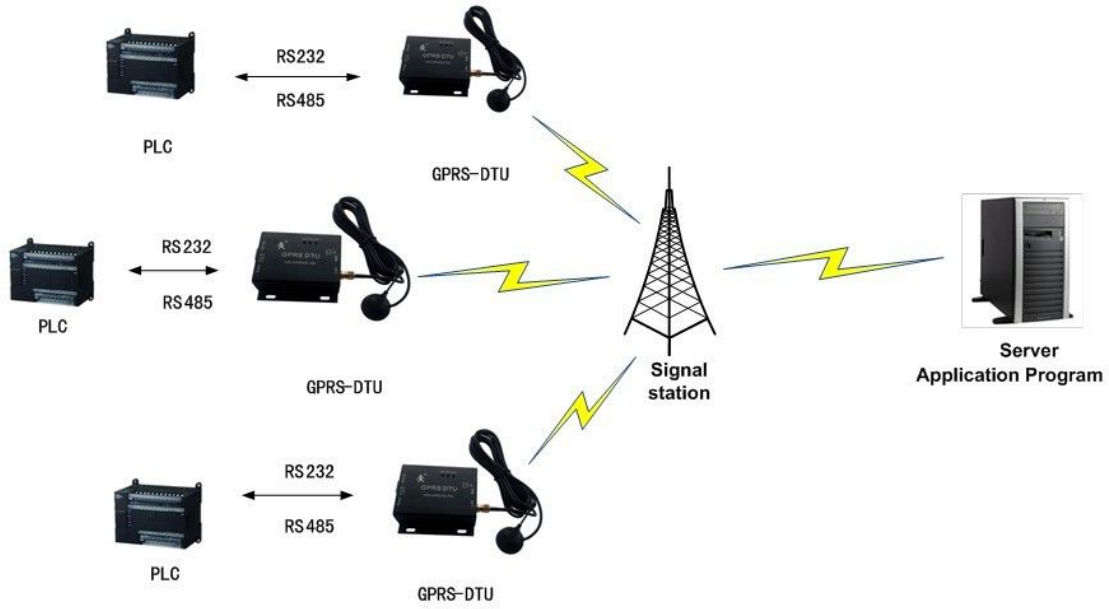
- If your public IP address problem has been solved, so your PC will have the condition as DTU data collection center, then you can test and use DTU.

5. Application Environment Testing

There are three application environment testing, as belows:

1. The application of public network server
2. The application of router transit
3. The application of server transit

5.1. Application of Public Server

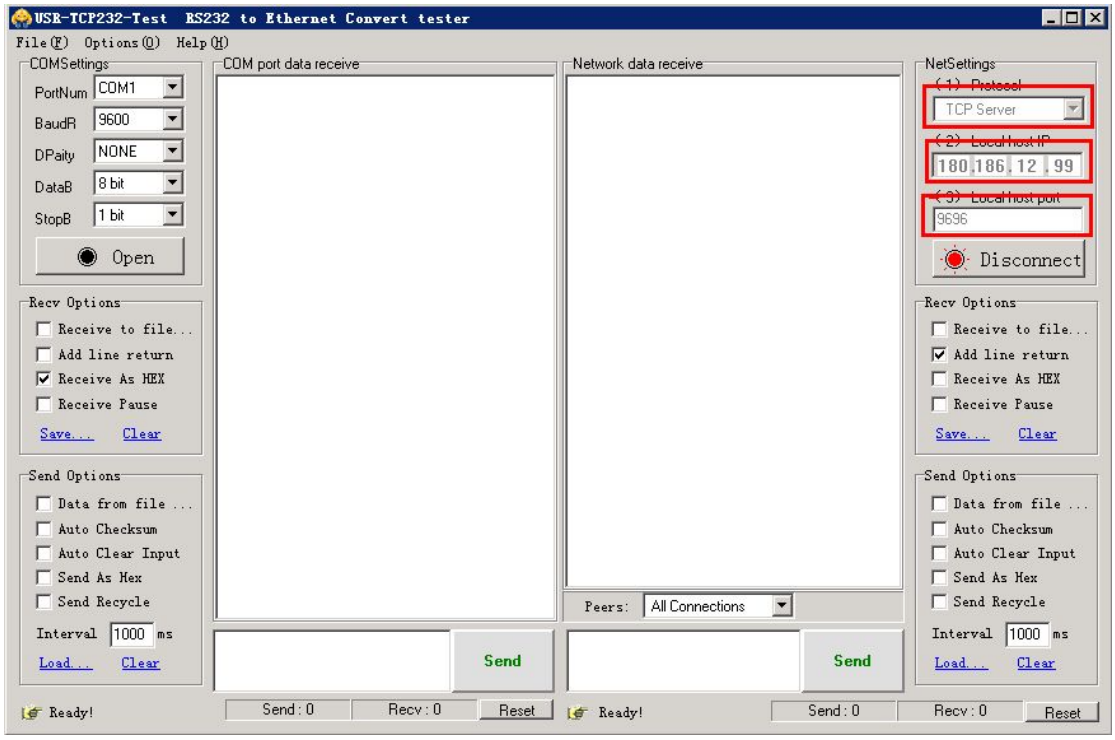


1. Testing target: Server software and local device can be in two way transmission by DTU

2. Testing request: DTU serial port connected with PC serial port

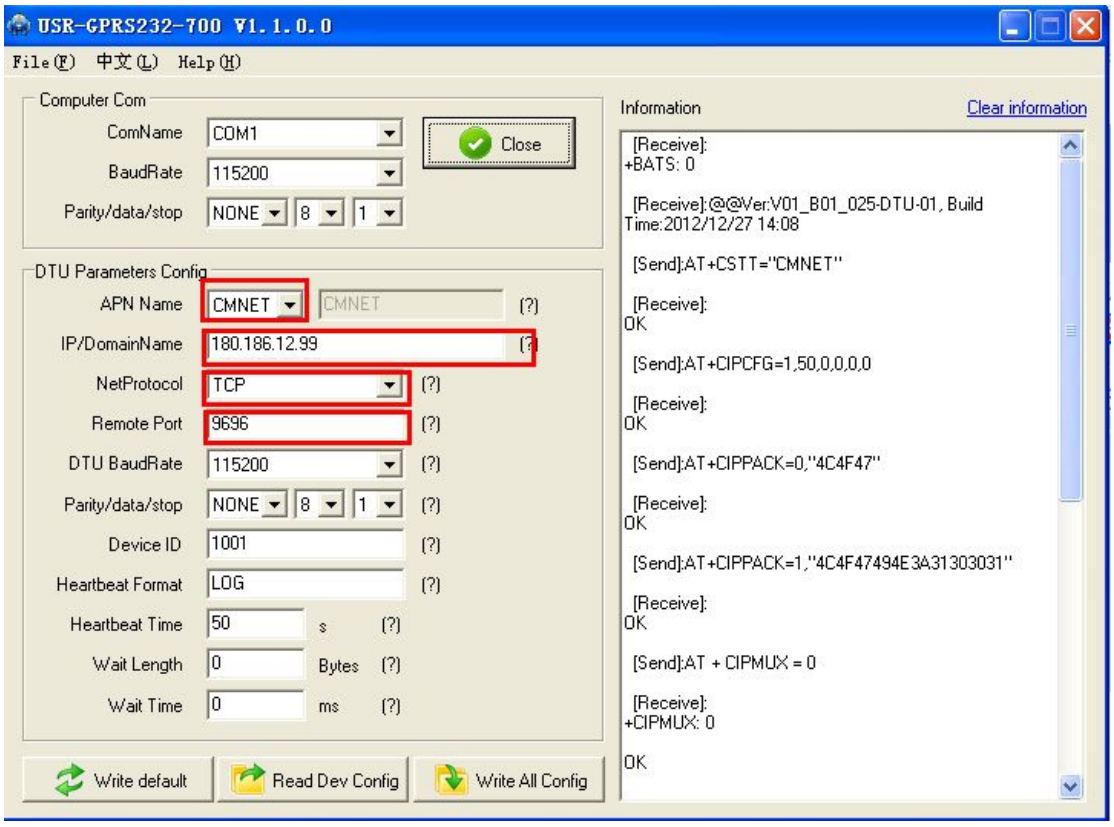
3. Testing tool: USR-TCP-232-Test debugging tool, DTU

4. Testing environment: Target server IP "180.186.12.99", Listening port"9696", protocol"TCP"



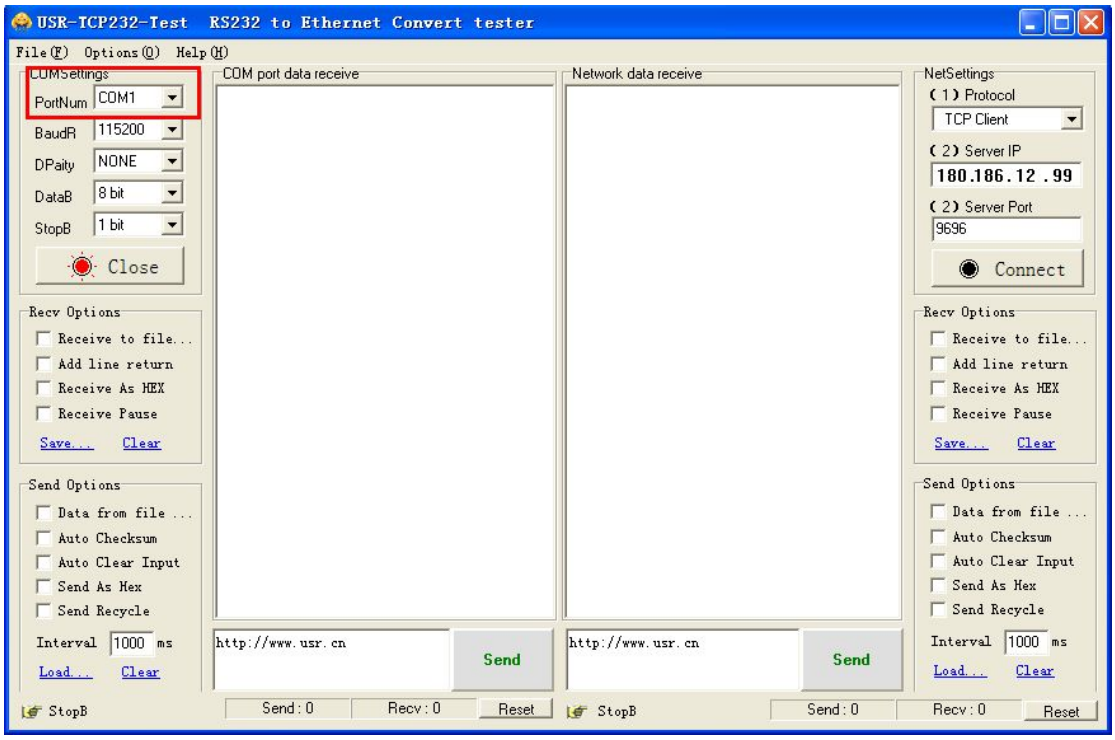
Note: Here we use USR-TCP232-Test to simulative network server

5. Configuration

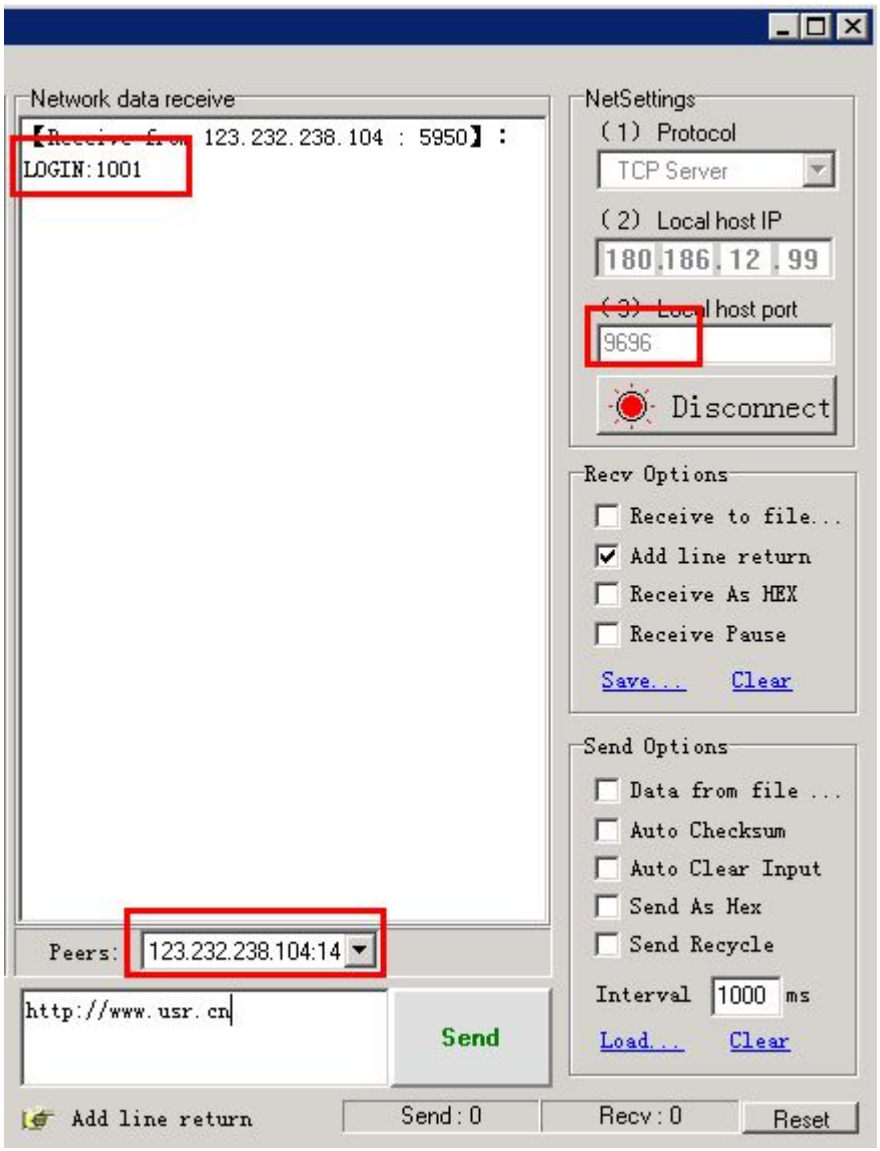


Note: We use China Unicom SIM Card, so it should be “UNINET”

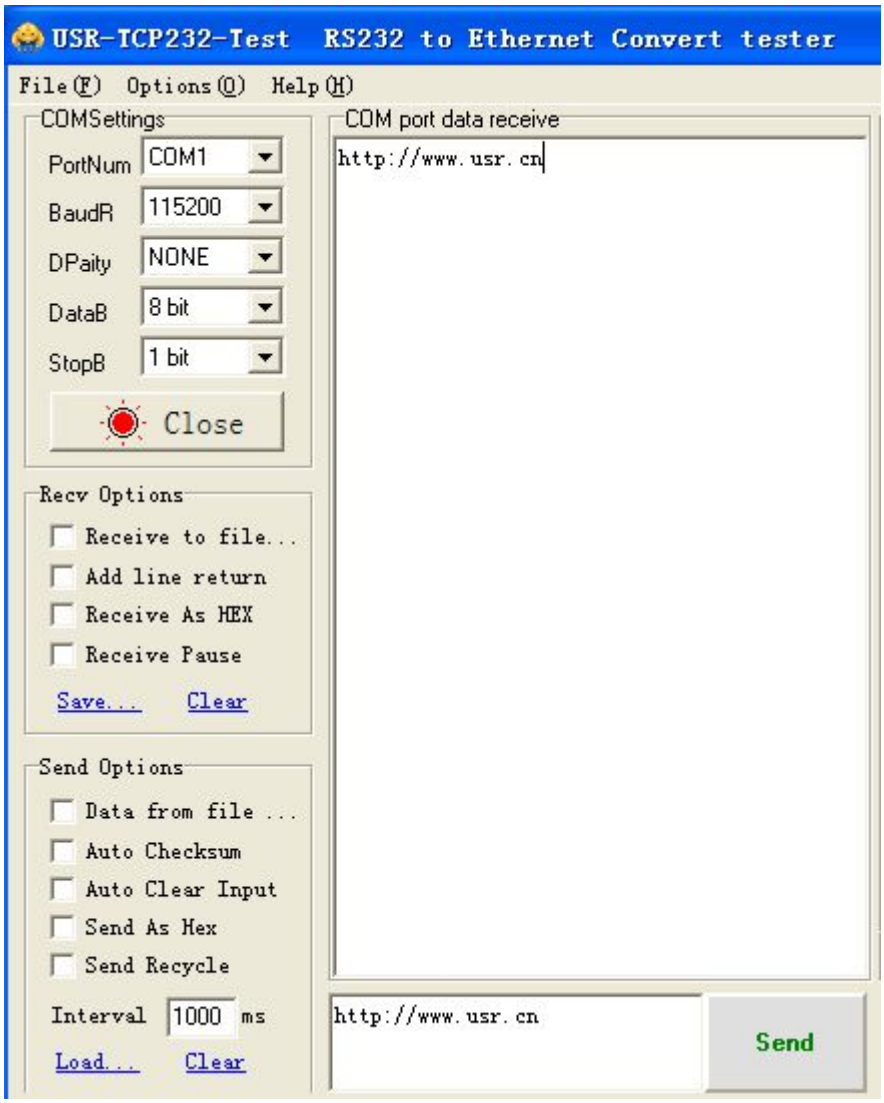
Power on and configurate DTU to, set the destination IP to server IP, destination port to server port, and baud rate default, then close the setup software. Open USR-TCP232-Test, start the serial port that connect with DTU(Mine is Com1)



Click “Send”, the server displays:

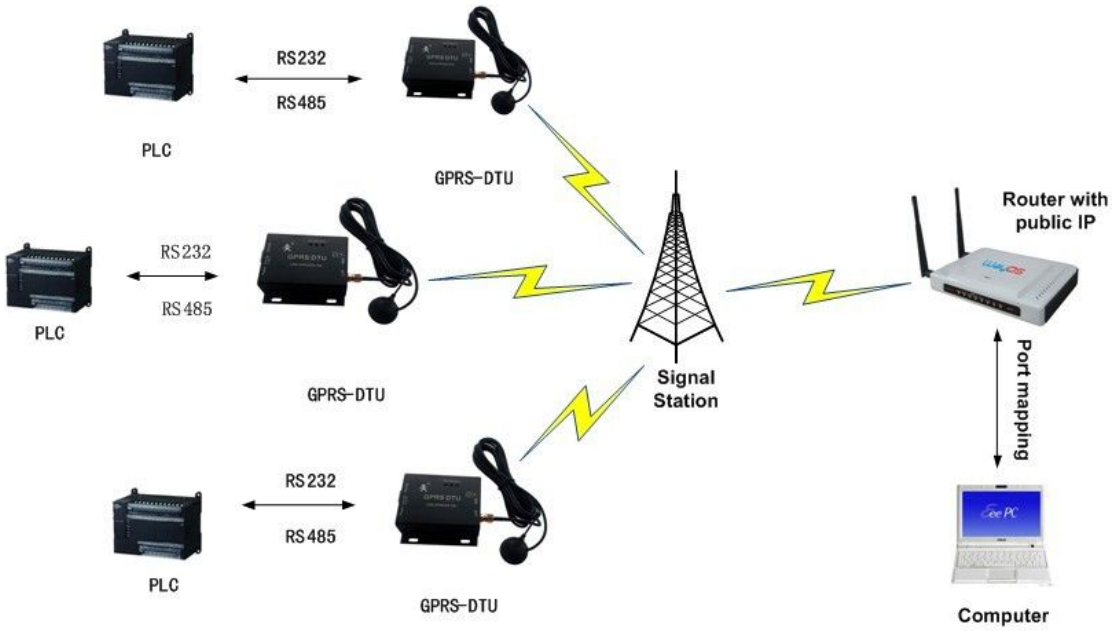


Already received data from DTU, click “send” on server side



The local can also receive data from server

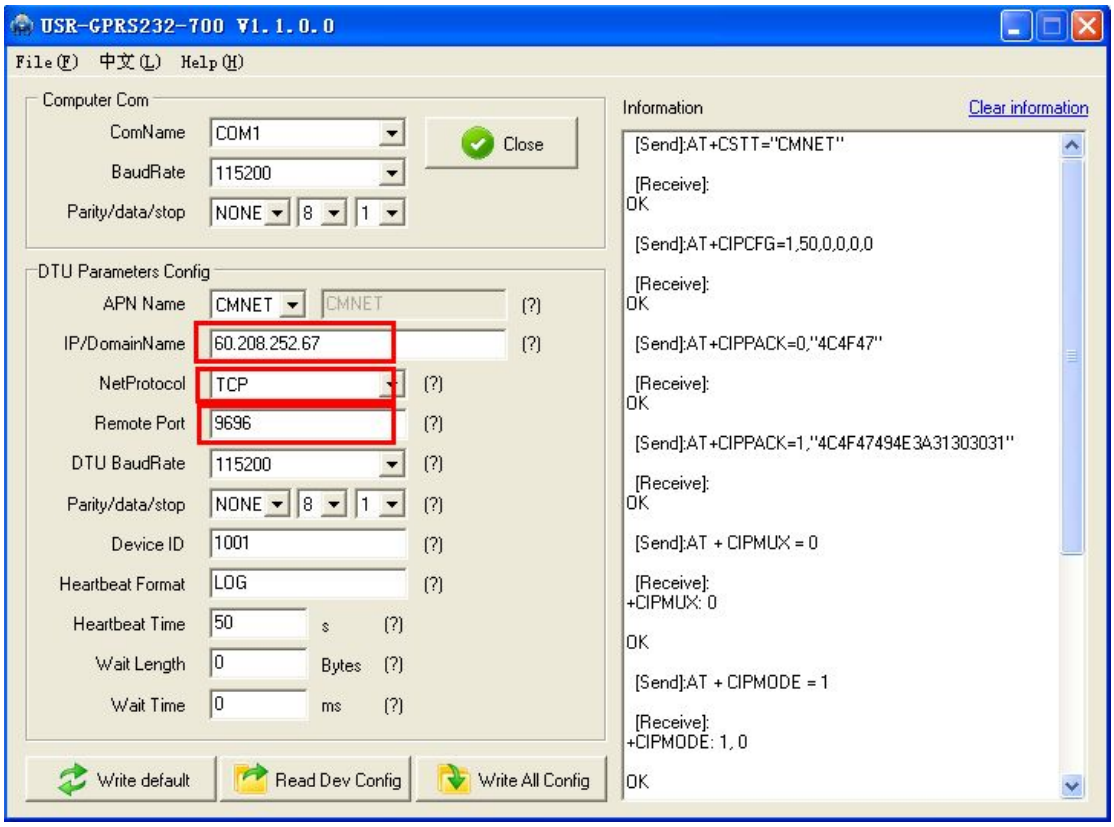
5.2. Application of Router Transit



1. Testing target: DTU send data to router, then router forward the data to destination PC
2. Testing request: DTU serial port connected with PC serial port
3. Testing tool: USR-TCP-232-Test debugging tool, DTU
4. Testing environment: Given router public network IP “60.208.252.67”, and has been set “port forwarding”. Forward port 9696 to the destination PC. Log in router page and set, for example, we use D-LINK router, steps: “ Internet connection” -->”Advanced”, as following picture:

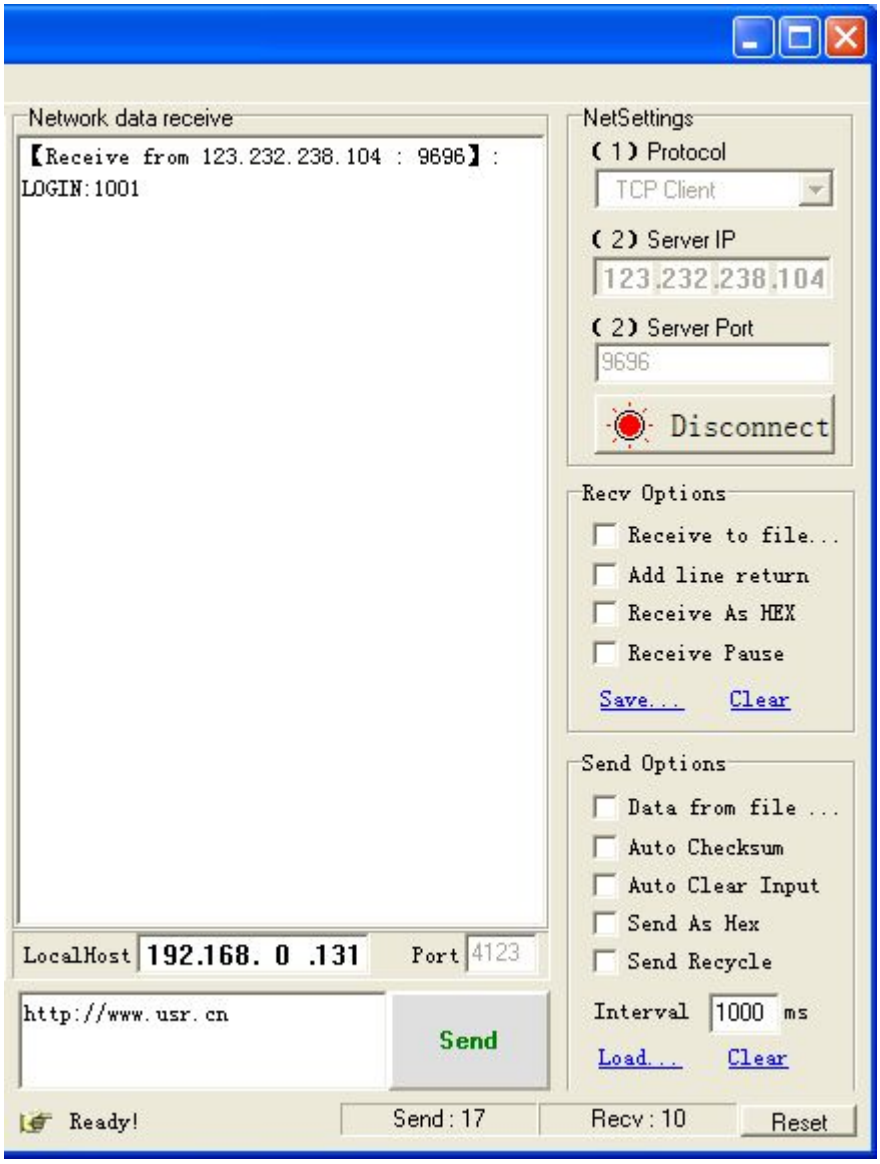
Restart router after finish settings.

5. Configuration

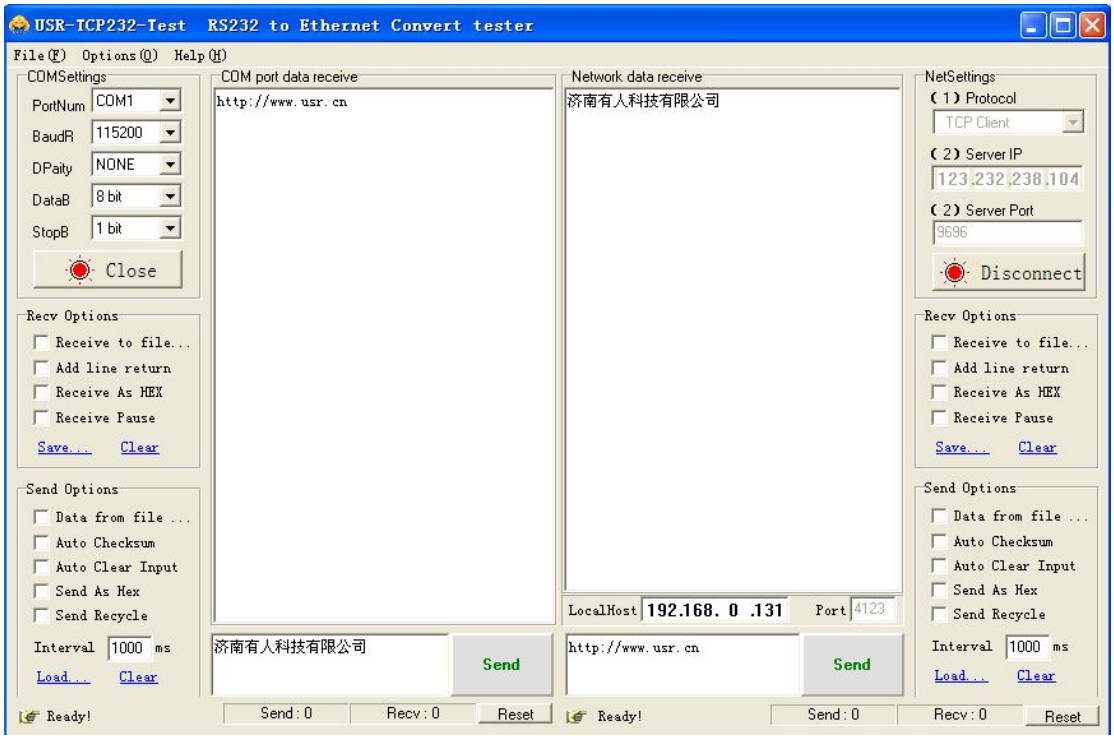


Set destination IP to router public network IP, remote port “9696”, net protocol “TCP”. Power on DTU again, click “Write All Config”, then close the software.

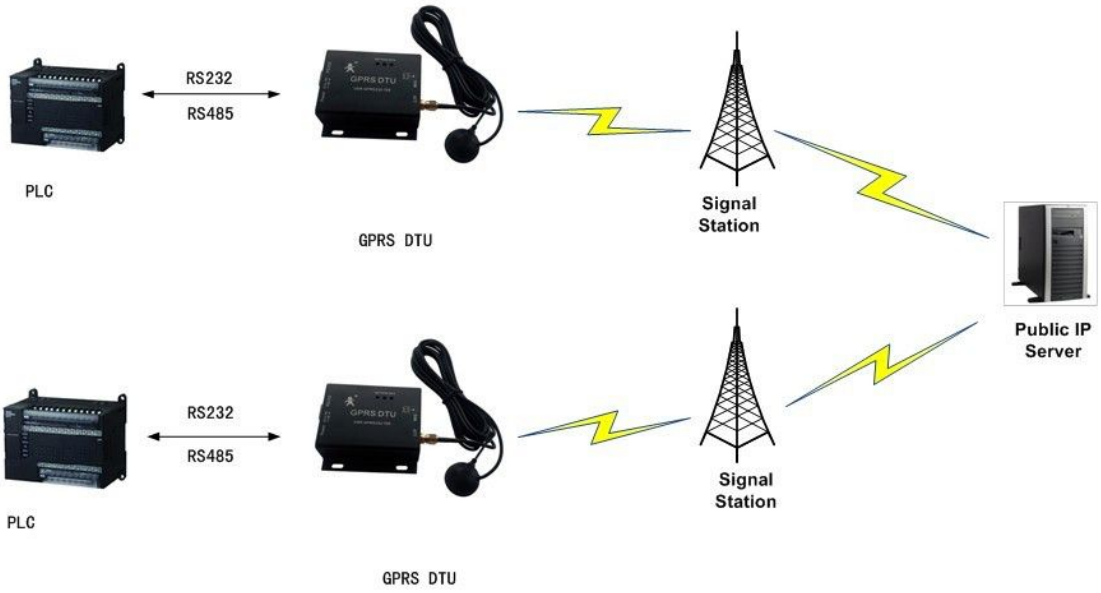
Open USR-TCP232-Test, as follows:



Set protocol"TCP Server", server port "9696", click "listening". There will be connection after a moment. Then DTU can have two way communication with PC.

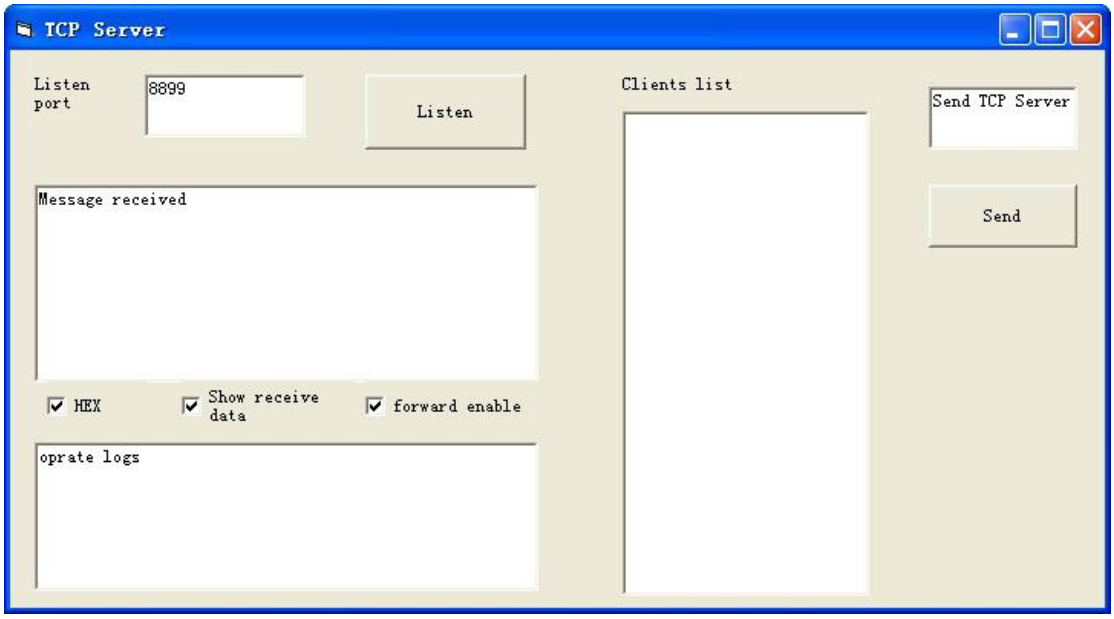


5.3. Application of Server Transit



In this mode, DTU data will be sent to our company server, and then the server forward data to destination DTU, to achieve remote communication between two DTU.

This function need the supporting of transfer program on server. We can supply a simple transfer sample testing program. Picture as follows:



6. AT Command

AT+ command use command line that based on ASCII code, command format as follows:
<CR> <LF> means carriage returns, line feeds
<CR> means “\r”, decimal ASCLL code is 13, hexadecimal code is 0x0D;
<LF> means '\n', ASCII code is 10, hexadecimal is 0x0A
<CR> <LF> means Carriage return, line feed. Pls input carriage returns and line feed but not those characters.

6.1. Set Key Parameter

1. Set DTU APN account (Default: Mobile CMENT)
Send
AT+CSTT=<apn><CR><LF>
Note: <apn> is character string
return
<CR><LF>OK<CR><LF>

For example:
China Unicom: AT+CSTT="UNINET"<CR><LF>
China Mobile: AT+CSTT="CMNET"<CR><LF>

2. Set DTU automatic startup mode, automatic reconnect waiting time after off line

Send
AT+CIPCFG=<auto_start>,<keepalive_wait>,<hex_packet>,<wait_time>,<wait_data_len><CR><LF>
return
<CR><LF>OK<CR><LF>

Parameter instructions

parameters	value	instructions
<auto_start>	[0], 0-1	This specifies whether the module automatic recovery to original saved network connection context(including TCP/UDP connections, transparent transmission mode etc.), need AT + CIPSCONT command cooperate to use
<keeplive_wait>	[50], 1-86400	If specified need automatic reconnection when start the network link, then after the link is accidentally disconnected, waiting for <keeplive_wait> seconds, will reestablish the server connection. This configuration effective for client only. If specified need sending heartbeat packet when start the network link, in links space <keeplive_wait> seconds, will automatically send heartbeat packet to server. This configuration effective for client only.
<hex_packet>	0-1	Whether internal command need be sent in hexadecimal text
<wait_time>	[0], 0-3600000	Unit: ms, effective in transparent transmission mode only When serial port receive less <wait_data_len> bytes data, and the module waiting for <wait_time> milliseconds later, still didn't receive serial data, then will start sending buffer data
<wait_data_len>	[0], 0-65535	Unit: byte, effective in transparent transmission mode only Module will send to connected server immediately after receiving <wait_time_len> bytes data

6.2. Configure DTU business Packet

With AT+CIPPACK command to set data format of each DTU business packet.

When the module is establishing a connection,which specifies send some command protocol packet, such as register packet、 heartbeat packet. Parameter definition is as belows:

0 - Heartbeat packet
1 - Device register packet (Device ID)

a. Heartbeat packet set
Send
AT+CIPPACK=0,<keepalive_packet><CR><LF>
Return
<CR><LF>OK<CR><LF>
Note: <Keepalive_packet> is hexadecimal character string

b. Device register packet (Device ID) set
Send
AT+CIPPACK=1,<register_packet><CR><LF>
Return
<CR><LF>OK<CR><LF>
Note: < register_packet> is hexadecimal character string

The data format definition of heartbeat packet or other data packet, each byte is called Hexadecimal character string, maximum support 80 bytes hexadecimal heartbeat packet.

Example:
AT+CIPPACK=0,"4C4F47" Configure DTU heartbeat packet data format
AT+CIPPACK=1, "4C4F47494E3A31303031" set module register packet “LOGIN:1001”

6.3. Set TCP/IP

1. Link Mode: Support single link mode only, as this device in transparent transmission mode

Configure single link mode
Send
AT+CIPMUX=0<CR><LF>
Return
<CR><LF>+CIPMUX:0<CR><LF>OK<CR><LF>

Configure common data mode
Send
AT+CIPMODE=1<CR><LF>
Return

<CR><LF>+CIPMODE:1,0<CR><LF>OK<CR><LF>

2. Configure a TCP or UDP client link, and automatic reconnection(Only start one client link in single link mode). All parameter will be kept in the module after running this command. Note: Need configure APN account of GPRS, method as follows:

Send

AT+CIPSCONT=<mux>,<net_protocol>,<ip_address>,<ip_port><link_mode><CR><LF>

Return

<CR><LF>OK<CR><LF>

Note: <net_protocol>,<ip_address> is character string

<mux>: Single link mode, default 0

<net_protocol>: Network protocol type

<ip_address>: IP address

<ip_port>: Port

<link_mode>: Link mode

0:Don not need to keep long link

1: Specify whether it need reconnect to server, after the link idle specified time value

2: Send customized heartbeat packet and keep long link, after link in specified idle time value

For example

AT+CIPSCONT=0,"TCP","182.32.112.178",7000,2 single link mode, network protocol is TCP, IP is 182.32.112.178, port 7000, link mode is 2

6.4. Set Serial port parameter

1. Baud rate operation

a. Inquiry

Send

AT+CIPR?<CR><LF>

Return

<CR><LF>+CIPR:<rate><CR><LF>OK<CR><LF>

b. Setting

Send

AT+CIPR=<rate><CR><LF>

Return

<CR><LF>OK<CR><LF>

Baud rate setting successfully. Then, work as per new baud rate.

<rate> Range of value: 110, 300, 600, 1200, 4800, 9600, 14400, 19200, 38400, 56000, 57600, 115200

2. Serial data bit, parity bit, stop bit settings

a. Inquiry

Send

AT+ICF?<CR><LF>

return

<CR><LF>+ICF:<format>,<parity><CR><LF>OK<CR><LF>

b. Setting

Send

AT+ICF=<format>,<parity><CR><LF>

Return

<CR><LF>OK<CR><LF>

Setting successfully. Then, work as per new data bit, parity bit, stop bit.

With this command, can set start/ stop(asynchronous) frame format of the local serial port. When DCE receive DTE command and sending message text and result code, <format>,<parity> format as follows:

Format: 1: 8 data bit 2 stop bit
3: 8 data bit 1 stop bit
4: 7 data bit 2 stop bit
5: 7 data bit 1 parity bit 1 stop bit

Parity 0: odd Parity
1: even parity
3: No parity

Example:

Setting: 8 data bit, 1 stop bit, <format>,<parity>=3,3

6.4. Setting Example

```
//Power on, within 2-30 seconds, configure as follows:
AT+CSTT="CMNET"

OK

AT+CIPCFG=1,50,0,0,0,0

OK

AT+CIPPACK=0,"4C4F47"

OK

AT+CIPPACK=1,"4C4F47494E3A31303031"
```

```
OK

AT + CIPMUX = 0

+CIPMUX: 0

OK

AT + CIPMODE = 1

+CIPMODE: 1, 0

OK

AT+CIPSCONT=0,"TCP","124.128.16.120", 10000,2

OK

AT+ICF=3,3

OK

AT+CIPR=115200

OK
```

7. FAQ

Network can not connect to the server

Please follow the following steps to troubleshoot

1) Use this software

to read DTU device configuration, to check destination IP, port, APN account and so on
2) Check SIM card model, make sure it has opened GPRS flow, not owning money, make sure the card is plugged in well, antenna connection, power indicator light
3) Use this software

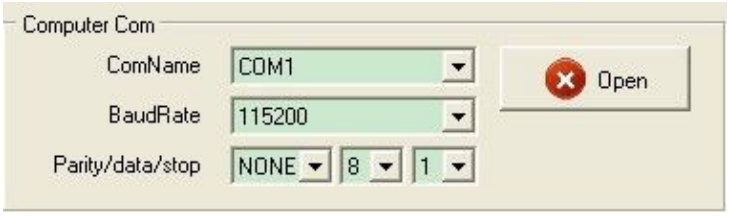
establish a TCP Client on a PC which can connect to Internet, then connect with the server. If connection is ok, the

server is working well, otherwise, the server may have some problems

4) If step 1) 2) 3) all right, but DTU still can not connect, pls change another SIM card or check hardware connection

Serial port can not connect with DTU to config

1) Confirm your interface, RS232, RS485 or TTL
2) Computer com baudrate, default is 115200, if you have changed this before, pls use the new one as you set



3) For RS232 interface, pls use the matched serial cable we send in your package; for RS485 interface, use qualified RS232 to RS485 adapter(recommend HEXIN active RS232 to RS485 adapter); for TTL interface, need serial to TTL level conversion then connect with PC

SIM Card

Do not support 3G, EDGE and CDMA
Only support 2G and 2.5G

8. Contact

Company: Jinan USR IOT Technology Co., Ltd

Address: 1-728, Huizhan Guoji Cheng, Gaoxin Qu, Jinan, Shandong, China

Tel: 86-531-55507297 86-531-88826739-803

Web: www.tcp232.net

Email: freda@usr.so

9. File history

V1.0	file established
V1.5.4	add radio consumptionand 4 fre description
V1.6	add GPRS232-701 description